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(71) Applicant *(for all designated States except US)*: NOKIA NETWORKS OY [FI/FI]; P.O. Box 300, FIN–00045 Nokia Group (FI).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: VIRTANEN, Terhi [FI/FI]; Nokia Telecommunications Oy, P.O. Box 319, FIN–90651 Oulu (FI).

(74) Agent: PELLMANN, Hans–Bernd; Tiedtke–Bühling–Kinne, Bavariaring 4, D–80336 München (DE).

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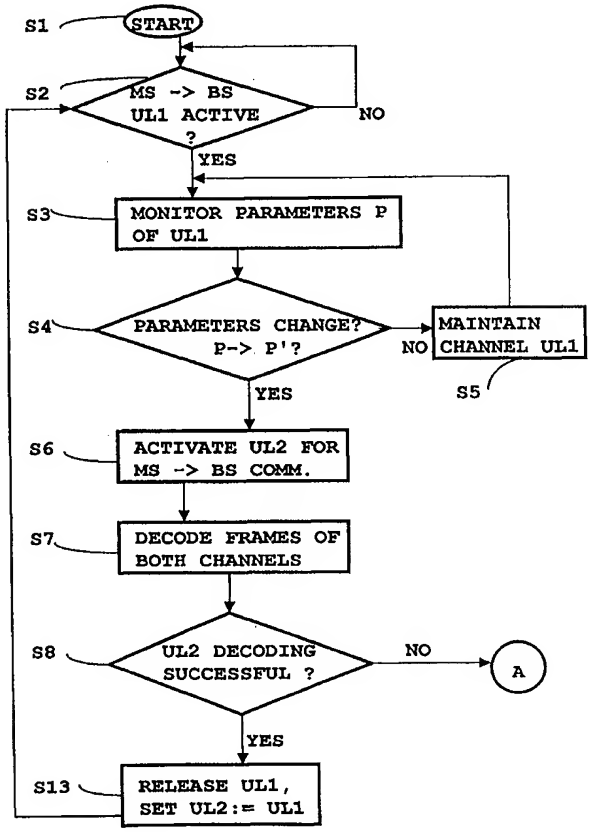
(54) Title: A METHOD OF BASE STATION RECONFIGURATION

(57) Abstract

The present invention proposes a method for assigning communication channels between a first radio transceiver device (MS) and a second radio transceiver device (BS) in a radio communication network, the method comprising the steps of: monitoring (S2, S3) parameters (P) of an assigned first communication channel (UL1), detecting (S4) a request for changing (P') said monitored parameters (P) of said first communication channel, activating (S6), upon detection of a request for a parameter change, a second communication channel (UL2) for communication between said first and said second radio transceiver devices, decoding (S7) both communication channels, judging (S8), whether said additionally activated, second communication channel (UL2) has been decoded successfully, and, upon judging (S8) that said second channel has been successfully decoded, releasing (S13) said first communication channel (UL1) an continuing communication using said second communication channel (UL2) only. The present invention also proposes a corresponding device.



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A METHOD OF BASE STATION RECONFIGURATION

FIELD OF THE INVENTION

The present invention relates to a method and apparatus for assigning communication channels between different radio transceiver devices in a radio communication network. In particular, the present invention is directed to a method and apparatus for providing a seamless recovery of a radio channel reconfiguration failure on data transmission channels between different radio transceiver devices in a cellular radio communication network.

BACKGROUND OF THE INVENTION

Recently, radio telecommunication networks for mobile communication have become very popular. Such radio communication networks establish mutual communication between mobile radio transceiver devices as first radio transceiver devices, hereinafter referred to as mobile station MS, of respective subscribers.

Such cellular networks generally consist of a plurality of stationary radio transceiver devices as second radio transceiver devices, hereinafter referred to as base stations BS. Each base station can be assumed to be controlled by a radio network controller device RNC. Communication between different mobile stations MS is established via at least one intermediate base station BS. A respective base station BS defines a radio cell by its radio coverage area. A mobile station MS present within such a cell establishes a radio connection with the respective base station BS of the cell.

The transmission principle adopted in such cellular radio networks is generally based on multiple access methods. According to such methods, plural subscribers share the same channel, for example according to a known scheme of time divisional multiple access (TDMA) or according to a scheme known as wideband code divisional multiple access (W-CDMA). (The transmission principles are for example specified in the GSM recommendations, issued by the European Telecommunication Standards Institute (ETSI). A (physical) channel, in connection with TDMA transmission, is thus divided into time slots to be assigned to respective subscribers for communication, the slots being grouped to form units of frames. While, according to W-CDMA, there are radio frames that are divided into slots, but slots are assigned to the same user. According to W-CDMA, the multiple access is based on the code used in transmission, and not on time.) The data transmitted in such frames comprise actual information to be transmitted between the subscribers (e.g. speech data) as well as control data used for establishing and/or maintaining a communication channel between subscribers and/or a subscriber MS and a respective base station BS. Data are transmitted from the respective mobile station MS to the base station BS of the cell in a so-called uplink transmission UL, and data are transmitted from the base station BS to the respective mobile station MS in a so-called downlink transmission DL. The respective channels for uplink and downlink transmission are physically different from each other, and each base station BS is designed so as to provide at least one channel for uplink and downlink transmission, respectively. However, a base station may be adapted to provide a plurality of different channels for each transmission direction, uplink UL or downlink DL, respectively.

Actual transmission in radio communication networks is effected via the radio path between a subscriber MS and the base station BS of the cell. The radio path (air interface Um) layer 1 (L1, physical layer) is the lowest layer of the transmission and is defined by its physical parameters and/or other properties P, P'. The radio path properties, having regard to physical parameters, include for example, the frequency, the signal power for transmission, and cell interference level. Layer 1 parameters at the radio interface include also for example forward error coding, interleaving, configuration of the layer 1 data stream multiplexing into the physical channel. The frequency of a physical channel may depend on the frequencies (channels) available at the base station side and/or on the traffic load within the cell, while the signal power as parameter depends on the environment of the base station (rural area with or without e.g. mountains and valleys) or densely populated city areas and/or the distance between the base station BS and a mobile station MS communicating with said base station.

Establishing new, releasing old or modifying already assigned sets of user data stream transfer services (bearer service), will consequently require modification of the parameters of the physical layer, e.g. new forward error coding or (as a CDMA specific parameter) channelization code, and also to take account of a changed environmental situation, e.g. due to the movement of the mobile station MS away from the base station with a mountain being in the line of sight from the base station BS to the mobile station MS.

A respective set of L1 parameters P, P' are supplied in the form of a data transmission (message) from the radio

network controller RNC to the base station BS and to the mobile station MS. Such a message may also include the starting time, i.e. the frame number, when the parameters are rendered valid. The message is transmitted via (logical) signaling channels dedicated for transmission of signaling information and represents a request for changing the set of actual parameters, e.g. from a set P to a modified set P'.

However, there may arise situations, in which the signaling procedure for changing and/or adapting the radio interface fails as such.

Additionally, even if the parameters are supplied to the mobile station MS, the mobile station, for some reasons, might not be able to apply the transmitted parameters. Then, there arises a situation that a set of new L1 parameters P' are only rendered valid on the network side, that is, used by the radio network controller RNC and the base station BS (under the assumption that the synchronization to the new set of L1 parameters is seamless), while the mobile station MS still relies on a hitherto valid set of parameters P for communication.

Apparently, this would result in a parameter mismatch between base station BS and mobile station MS. Consequently, this might cause the detection of a radio link failure by a mobile station MS. Furthermore, in WCDMA, the physical channel used for data transmission from the mobile station MS to the base station BS (uplink UL) can no longer be decoded even if the synchronization to the dedicated physical control channel is not lost.

The above described phenomena will result in a failure, which in turn will result in a communication (call) to be

dropped (or not to be established) if the parameter mismatch is not corrected.

Additionally, in general a failure can be noticed at the network side, at minimum, after one period of interleaving (interleaving denoting an error control technique for changing burst errors into random errors, as described in literature, e.g. in "Introduction To Digital Mobile Communication", by Y. Akaiwa, pp. 287 ff., John Wiley & Sons, New York, USA, 1997). However, a plurality of interleaving periods are required to take decisions concerning channel state. Therefore, informing the radio network controller of a channel failure can only take place after detection of the failure.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method and corresponding device for assigning communication channels between a first radio transceiver device and a second radio transceiver device in a radio communication network, which is free of the above mentioned drawbacks. In particular, the present invention aims to provide a method and device for seamless recovery of radio channel reconfiguration failure on the network side.

This object is achieved by a method for assigning communication channels between a first radio transceiver device and a second radio transceiver device in a radio communication network, the method comprising the steps of monitoring parameters of an assigned first communication channel, detecting a request for changing said monitored parameters of said first communication channel, activating, upon detection of a request for a parameter change, a

second communication channel for communication between said first and said second radio transceiver devices, decoding both communication channels, judging, whether said additionally activated, second communication channel has been decoded successfully, and, upon judging that said second channel has been successfully decoded, releasing said first communication channel and continuing communication using said second communication channel only.

Furthermore, the above object is achieved by a device for assigning communication channels between a first radio transceiver device and a second radio transceiver device in a radio communication network, comprising monitoring means adapted to monitor parameters of an assigned first communication channel, detection means adapted to detect a request for changing said monitored parameters of said first communication channel, activation means adapted to activate, upon detection of a request for a parameter change, a second communication channel for communication between said first and said second radio transceiver devices, decoding means adapted to decode both communication channels, judging means adapted to judge, whether said additionally activated, second communication channel has been decoded successfully, and, releasing means adapted to release said first communication channel and continuing communication using said second communication channel only, upon reception of a judgment result that said second channel has been successfully decoded.

Advantageous further developments of the present invention are as defined in the respective dependent claims.
Due to the method and device according to the present invention, the following benefits and improvements are realized:

(1) Radio parameters P of the physical L1 layer can securely be redefined upon occurrence of a parameter change.

(2) The dropped call rate, i.e. the number of dropped calls, can be reduced.

(3) In connection with networks operating according to WCDMA principle, a failure occurring upon radio channel reconfiguration can be detected sooner, most probably already after a single interleaving period. Also, recovery of a (failed) radio channel reconfiguration does not cause any data losses in transmission in uplink direction UL.

(4) In case of a successful reconfiguration, the radio network controller need not be informed about the whole reconfiguration procedure (temporary resource activation and deactivation), which is handled by the base station. Therefore, the processing load for the radio resource management on the network controller side is reduced.

BRIEF DECRIPTION OF THE DRWAINGS

The present invention is described herein below with reference to the accompanying drawings, in which

Fig. 1 schematically shows part of a radio communication network;

Fig. 2 (consisting of Figs. 2A & 2B) represents a flowchart illustrating the method and the operation of the accordingly adapted device, according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

According to the present invention, in case a set of air-interface parameters P changes (or is changed) to a set of new parameters P' of the layer 1 (referring to the layer 1 according to OSI/ISO communication layer model), already assigned ("old") layer 1 uplink and/or downlink parameters are kept active at the base station BS until the mobile station MS has started to use the new communication channel successfully.

Stated in other words, for example in connection with uplink transmission (UL), new hardware resources at the base station BS side are activated for a new communication channel UL2 which is characterized by a new set of parameters P', without releasing those resources allocated for the previously assigned ("old") radio communication channel UL1. To be precise, there is one physical channel transmission from the mobile station MS to the base station BS, but there are two receiving units R at the base station BS side which respectively operate using different layer 1 parameters for a respective mobile station MS. Then only one of these receiving units R at the base station BS may receive a signal from the mobile station MS which can provide correct decoding results.

If also in the downlink DL direction both, new and old layer 1 parameters are kept active, it means that there are two transmitting radio communication channels (transmitter units of the base station) active.
Fig. 1 schematically shows such a situation as explained above. A radio network controller device RNC communicates with and controls a base station BS of a radio network. However it should be understood that in practice, a radio network controller device RNC controls a plurality of base stations of the network. The base station BS communicates

with a mobile station MS present within the cell of the base station.

In particular, data transmission in uplink direction UL from the mobile station MS to the base station BS is effected by using an uplink communication channel (UL1, using parameter set P, or UL2, using parameter set P'). In the depicted example, the used uplink communication channels UL1, UL2 differ in the respective set of layer 1 (L1) parameters P, P'. Data transmission in downlink direction DL from the base station BS to the mobile station is effected by using a downlink channel DL. At the base station side, the reception of the data transmitted in uplink direction is then achieved by two activated receiving units (in Fig. 1 denoted with R) within the base station, each using a different parameter set P, P' for reception.

It should be understood that the depicted situation is an example only. Commercially available base stations may have a plurality of channels, exceeding two uplink and/or one downlink channel, respectively, and Fig. 1 merely shows the minimum requirements for a base station in which the present invention may be implemented. The present invention merely requires that the base station has enough hardware resources for temporarily allocating additional (e.g. the double) amount of hardware resources for connection. In case more than one mobile stations MS communicate simultaneously with the base station BS, then there should be enough hardware resources and communication channels so that for each mobile station MS two different channels may be assigned for communication which are not used for communication at the same time within the cell of the base station BS. For simplification of the further explanation,

however, the following description will refer to a single mobile station MS only.

Fig. 2 represent a flowchart illustrating the method and the operation of the accordingly adapted device. The device (not shown in Fig. 1) forms part of the base station BS shown in Fig. 1.

Referring now to Fig. 2A, the entire procedure starts in step S1. In the subsequent step S2, it is checked whether an uplink communication channel, e.g. UL1, between a respective mobile station MS and the base station BS is active. Such an uplink communication channel is received at one of at least two receiving units R available at the base station BS for uplink communication channels, which in the depicted example of Fig. 1 is denoted as R[UL1(P)]. In case there is no uplink communication channel detected as being active (NO in step S2), the procedure loops until a first uplink communication channel UL1 is detected as being active (YES in step S2). In response to such a detection, the set of L1 parameters P of said communication channel UL1 is monitored in step S3. In step S4, there is detected whether a change in the previously monitored parameters P has meanwhile been instructed from the radio network controller RNC side to be changed. If no request / instruction for a parameter change has been detected (NO in step S4), the previously assigned/activated receiving unit R[UL1(P)] for a communication channel UL1 (using layer 1 parameter set P for reception) is maintained (step S5) in uplink communication and the flow returns to step S3. If, however, a request for a change in the L1 parameter set has been detected, i.e. a new communication channel UL2 with new parameters P' is to be activated, the procedure advances to step S6. In step S6 an additional new receiving unit R[UL2(P')] for a communication channel UL2 (using

layer 1 parameter set P' for reception) in uplink communication between the mobile station MS and the base station BS is activated. It is to be noted that in such a situation, both receiving units R of the base station BS for communication channel UL1 and UL2 are simultaneously active, while there is still only one physical channel transmission from the mobile station MS to the base station BS.

In a subsequent step S7, the data transmitted on the uplink physical channel are decoded for both sets of L1-parameters (P, P') of communication channels UL1, UL2. Subsequently, in a step S8, it is judged whether the decoding of the data transmitted using the additionally activated receiving unit for a communication channel UL2 was successful. If the decoding of transmitted data for a set of L1 parameters specifying communication channel UL2 failed, i.e. decoding was judged to be erroneous, (NO in step S8), the method flow branches and continues with step S9 (Fig. 2B).

With reference now to Fig. 2B, it is determined in step S9 whether the decoding of transmitted data for a set of L1 parameters representative of communication channel UL1 has still been successful. If also the decoding of transmitted data using the parameter set P defining communication channel UL1 has been determined to have failed (NO in step S9), the flow proceeds to step S10. In step S10 it is then confirmed that the communication (call) has been terminated or dropped, since no data could be decoded using either of the sets of parameters defining communication channels UL1, UL2. If, however, the decoding using the parameter set for the communication channel UL1 has been successful (YES in step S9), the flow proceeds to step S11. In step S11, the communication continues using the initially assigned parameters for channel UL1 (with "old" parameters P).

Namely, receiving unit R[UL1(P)] is continued to be used, while receiving unit R[UL2(P')] is released to be in an idle state again. This assures, that no data will be lost due to the fact that a new communication channel UL2 having the new parameters P' could not be successfully established. Subsequently, in step S12, the radio network controller RNC is informed of the fact that the new channel UL2 could not be established for communication between the mobile station MS and the base station BS. The radio network controller RNC may then initiate another appropriate action to establish a new communication channel with a changed parameter set.

Referring again to Fig. 2A, if the decoding of transmitted data using parameters indicating communication channel UL2 was successful, i.e. decoding was judged to be effected correctly, (YES in step S8), the method flow continues with step S13. In step S13, the previously assigned/active receiving unit R[UL1(P)] using parameters P for communication channel UL1 is released and communication between the mobile station MS and the base station BS is continued using the communication channel UL2, i.e. the receiving unit R using the set of communication channel parameters P' for reception. Then, the communication channel UL2 is the assigned communication channel and the flow returns to step S2. The processing is repeated in case a further parameter change is instructed.

It becomes clear from the above that there is only one physical channel transmission from the mobile station to the base station, but there are two receiving units at the base station with different layer 1 parameters (P, P') activated for the same mobile station MS, as schematically indicated in Fig. 1. Only one of these receiving units at

the base station side may then receive a signal which can be correctly decoded.

In has to be noted that although step S13 in Fig. 2A mentions to set UL2 as UL1, this is rather for explanation purposes when referring to two communication channels only. The properties of the communication channel UL2 are, of course, defined by its assigned set of parameters P'.

From the above, it becomes clear that according to the present invention always the communication channel which is able to provide successfully decoded L1 frames is selected at the base station BS side. In particular, in case of a successful reconfiguration, the radio network controller RNC need not be informed about the whole procedure of temporary radio resource activation and deactivation which is handled by the base station BS, so that the processing load for the radio network controller RNC is reduced. The radio network controller RNC is only involved again in case establishing the new communication channel with new parameters fails while the old channel can be maintained so that no data losses will occur and the call will not be dropped. This whole procedure is transparent for the mobile station.

The present invention has herein above been described for an example of a base station providing two uplink channels (receiving units R) only. However, in case more than two uplink communication channels UL are available, in step S6 there must be taken a decision as to which channel is selected for the new parameters.

As mentioned before, the present invention requires additional hardware resources (e.g. receiving units R in case uplink UL transmission is considered) for each

communication channel the parameter set of which is instructed to be changed. However, under the point of view of avoiding the provision of a large amount of normally unused hardware resources, it might not be desirable to constantly provide double amount of hardware resources with regard to all available channels. Under practical considerations, it could be considered that a single communication channel per base station BS to be additionally activated upon a requested change of a set of communication channel parameters might be sufficient. The reason therefore is that the probability of simultaneously instructed changes of parameter sets for communication channels at the base station BS side can be considered to be rather low.

To this end, measures can be taken to assure that at least one communication channel of all available communication channels of a base station BS may be assigned to be used in steps S3 through S13.

In particular, it can be provided for to inhibit establishing a new communication between mobile station MS and base station BS upon detection that the number of already assigned communication channels (ongoing calls) has reached the number of overall available communication channels minus one.

The description of the invention as given herein above has mainly be made considering the uplink transmission channels. Nevertheless, the downlink transmission resources may also be activated in a similar way as described above. This, however, requires that interference caused by the two channels is taken into account and is admissible under the radio resource scheduling requirements, since in connection

with CDMA all signals are transmitted simultaneously and interfere with each other.

It should be understood that the above description and accompanying figures are merely intended to illustrate the present invention by way of example only. The preferred embodiments of the present invention may thus vary within the scope of the attached claims.

CLAIMS

1. A method for assigning communication channels between a first radio transceiver device (**MS**) and a second radio transceiver device (**BS**) in a radio communication network, **the method comprising the steps of:**

monitoring (**S2, S3**) parameters (**P**) of an assigned first communication channel (**UL1**),

detecting (**S4**) a request for changing (**P'**) said monitored parameters (**P**) of said first communication channel,

activating (**S6**), upon detection of a request for a parameter change, a second communication channel (**UL2**) for communication between said first and said second radio transceiver devices,

decoding (**S7**) both communication channels,

judging (**S8**), whether said additionally activated, second communication channel (**UL2**) has been decoded successfully, and,

upon judging (**S8**) that said second channel has been successfully decoded, releasing (**S13**) said first communication channel (**UL1**) and continuing communication using said second communication channel (**UL2**) only.

2. A method according to claim 1, **further comprising**

a first maintaining step (**S5**) for maintaining said first communication channel (**UL1**) for transmission in case said detection step (**S4**) does not detect a parameter change.

3. A method according to claim 1 or 2,
further comprising the steps of

determining (**S9**) whether said first channel (**UL1**) has been successfully decoded, in case the decoding of said second channel (**UL2**) has failed, and

a second maintaining step (**S11**) for maintaining said first communication channel (**UL1**) for transmission in case the decoding of said first channel (**UL1**) has been successful.

4. A method according to claim 3,
further comprising the step of

informing (**S12**) a radio network control device (**RNC**) of the fact that radio communication between said first radio transceiver device (**MS**) and said second radio transceiver device (**BS**) could not be established using said second channel (**UL2**).

5. A method according to any of the preceding claims,
wherein
after activation of said second channel (**UL2**), both channels (**Ul1**, **UL2**) are temporarily simultaneously active

6. A method according to any of the preceding claims,
wherein
said communication is effected in units of frames defined according to GSM specification.

7. A method according to claim 6, **wherein**
said communication frames are defined according to a standard of wideband code divisional multiple access (**WCDMA**).

8. A method according to any of the preceding claims,
wherein
said radio channel assignment is effected for uplink transmission.

9. A device for assigning communication channels between a first radio transceiver device (**MS**) and a second radio transceiver device (**BS**) in a radio communication network, **comprising:**

monitoring means (**S3**) adapted to monitor parameters (**P**) of an assigned first communication channel (**UL1**),

detection means (**S4**) adapted to detect a request for changing (**P'**) said monitored parameters (**P**) of said first communication channel,

activation means (**S6**) adapted to activate, upon detection of a request for a parameter change, a second communication channel (**UL2**) for communication between said first and said second radio transceiver devices,

decoding means (**S7**) adapted to decode both communication channels,

judging means(**S8**) adapted to judge, whether said additionally activated, second communication channel (**UL2**) has been decoded successfully, and,

releasing means (**S13**) adapted to release said first communication channel (**UL1**) and continuing communication using said second communication channel (**UL2**) only, upon reception of a judgment result that said second channel has been successfully decoded.

10. A device according to claim 9, **further comprising**

first maintaining means (**S5**) adapted to maintain said first communication channel (**UL1**) for transmission in case said detection means (**S4**) does not detect a parameter change.

11. A device according to claim 9 or 10,
further comprising

determining means (**S9**) adapted to determine whether said first channel (**UL1**) has been successfully decoded, in case the decoding of said second channel (**UL2**) has failed, and

second maintaining means (**S11**) adapted to maintain said first communication channel (**UL1**) for transmission in case the decoding of said first channel (**UL1**) has been successful.

12. A device according to claim 11, **further comprising**

informing means (**S12**) adapted to inform a radio network control device (**RNC**) of the fact that radio communication between said first radio transceiver device (**MS**) and said second radio transceiver device (**BS**) could not be established using said second channel (**UL2**).

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FIG. 1

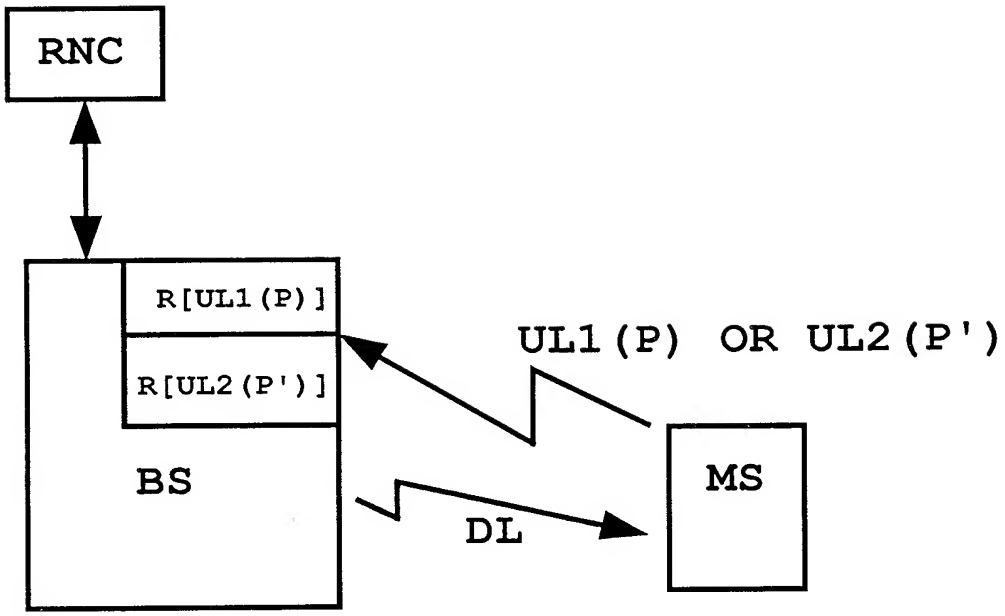


FIG. 2A

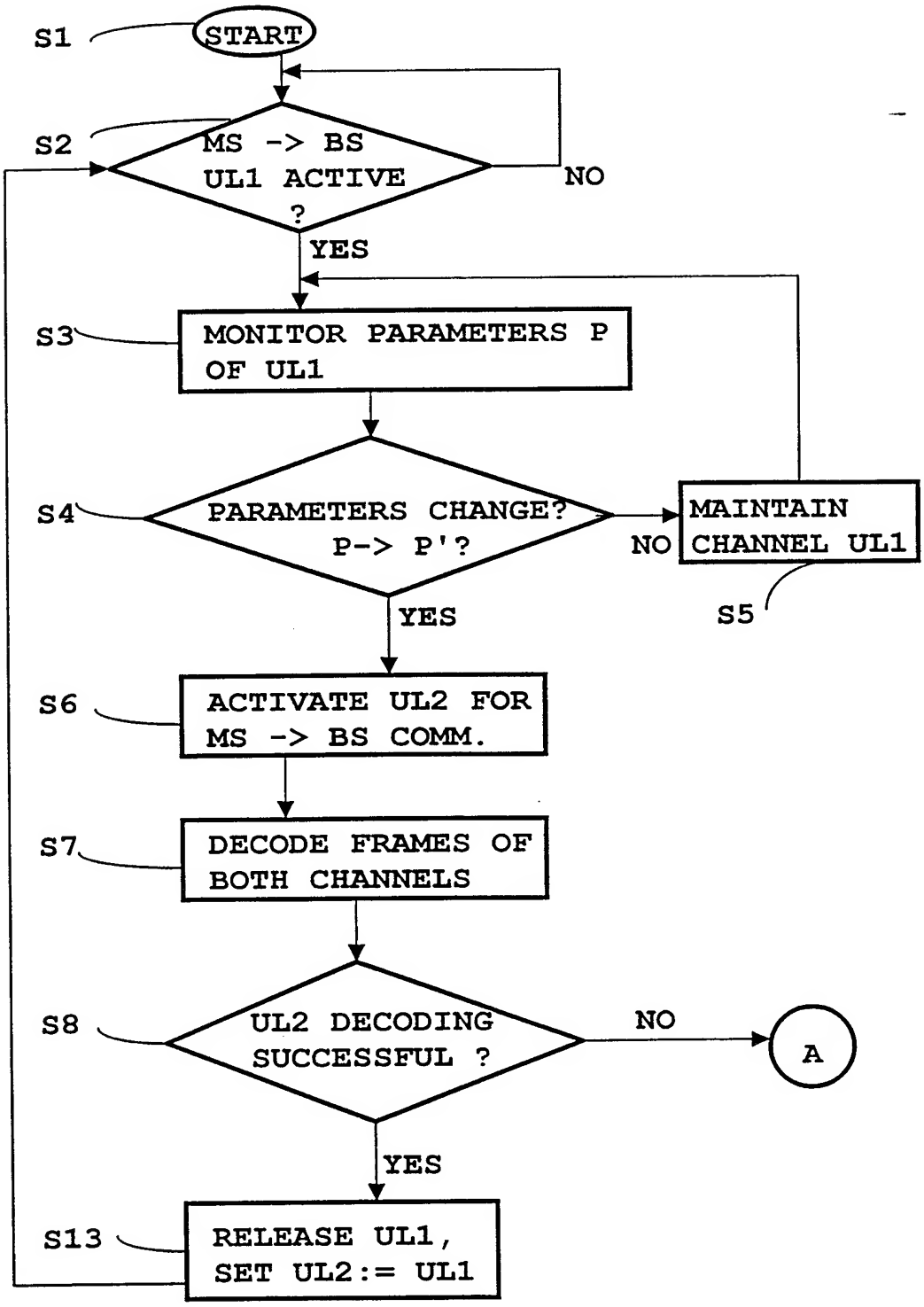
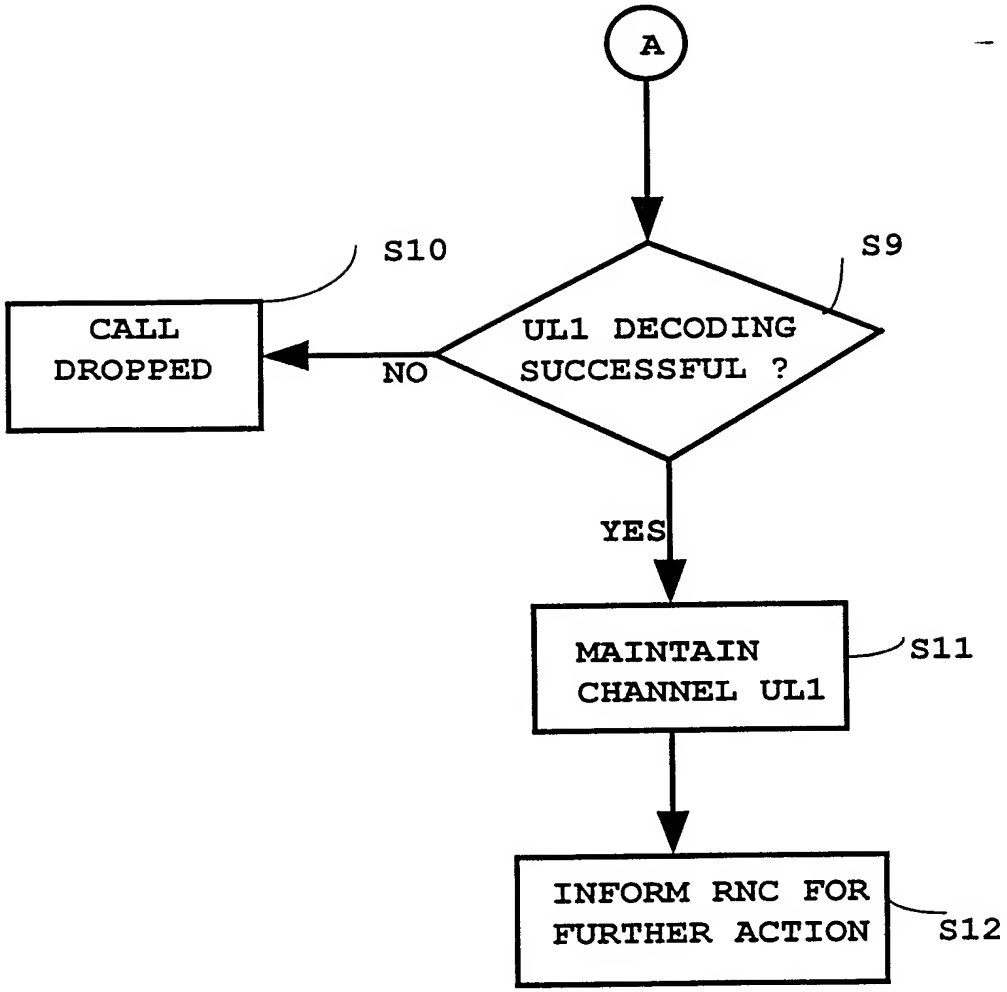

S1
START
S2
MS -> BS
UL1 ACTIVE
?
NO
YES
S3
MONITOR PARAMETERS P
OF UL1
S4
PARAMETERS CHANGE?
P-> P'?
NO
MAINTAIN
CHANNEL UL1
S5
YES
S6
ACTIVATE UL2 FOR
MS -> BS COMM.
S7
DECODE FRAMES OF
BOTH CHANNELS
S8
UL2 DECODING
SUCCESSFUL ?
NO
A
YES
S13
RELEASE UL1,
SET UL2:= UL1

FIG. 2B


A
S9
UL1 DECODING SUCCESSFUL ?
S10
CALL DROPPED
NO
YES
MAINTAIN CHANNEL UL1
S11
INFORM RNC FOR FURTHER ACTION
S12

INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/EP 98/05893

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 298 338 A (MOTOROLA LTD) 28 August 1996 see page 1, line 12 - line 38 see page 4, line 10 - page 8, line 18; figures 2-4	1,9
A	US 5 768 260 A (ISAKSSON GREGER ET AL) 16 June 1998 see column 1, line 65 - column 2, line 20 see column 7, line 46 - line 65	1,9
A	WO 97 24896 A (MCI COMMUNICATIONS CORP) 10 July 1997 see abstract	1,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
10 May 1999	26/05/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Burghardt, G

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INTERNATIONAL SEARCH REPORT

Information on patent family members

In ıtional Application No
PCT/EP 98/05893

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2298338 A	28-08-1996	NONE	
US 5768260 A	16-06-1998	SE 9301882 A	03-12-1994
WO 9724896 A	10-07-1997	NONE	